

Chapter 3:

Focus on Foodborne Illness

Estimated training time:

90 minutes

Educational objectives:

This chapter will teach trainees to...


- Recognize *common harmful microorganisms* found in the food service environment that may cause foodborne illness.
- Identify the *five factors that affect bacterial growth*:
 - food
 - moisture
 - time
 - temperature
 - pH (acidity vs. alkalinity)
- Identify the *three ways cross-contamination may occur*:
 - food to food
 - hand to food
 - equipment to food

Presentation outline:

There are 19 teaching aids to use with Chapter 3. Most are visuals which you can use with an overhead projector or copy and hand out. The last is a wrap-up exercise. As you will see:

Teaching Aids 3.2 through 3.9 introduce with playful cartoon characters the illness-causing “culprits” you want to stop

The teaching aids for Chapter 3 are listed on page 61.



in their tracks. To liven up your presentation, involve members of the class in a “role play” by asking individuals to read the scripts. Begin by reading out loud the scientific name of the culprit (there’s a pronunciation guide below), then ask trainees to read the sentences in quotation marks.

Teaching Aid 3.19 (the wrap-up exercise) is a group activity that brings workers face to face with some of the culprits. You’ll need to do a few things in advance for this activity.

Pronunciation guide:

“Tricky Trichinella” is...

TRICHINELLA (trick a nel’ a)

“Brazen Botchy” is...

CLOSTRIDIUM BOTULINUM (klo strid’ e um
boch’ e li nem)

“Savage Sam” is...

SALMONELLA (sal’ ma nel la)

“Pesky Perfy” is...

CLOSTRIDIUM PERFRINGENS (klo strid’ e um
per frin’ gens)

“Cocky E. Coli” is...

ESCHERICHIA COLI (es cher e che a kol’ i)

“Sinister Staph” is...

STAPHYLOCOCCUS AUREUS (staf e lo kok’ es
or’ e us)

• Microorganisms Are Everywhere

T E X T :

Bacteria and other microorganisms are everywhere. They can be found in the soil, in saliva, under your fingernails, on a door-knob, on a towel.

Some of them are good for us. For example...

Some bacteria protect us from infection, help digest food inside our bodies, and break down organic materials in the environment.

Penicillin, a powerful antibiotic, was originally developed from a mold.

However, some microorganisms are dangerous to humans when consumed. In fact, they are the primary cause of foodborne illness.

VISUAL OR HANDOUT:

Use Teaching Aid 3.1, “How Do Harmful Organisms Invade the Food Service Environment?”

T E X T :

How do these harmful organisms invade the food service environment?

Food may contain harmful organisms when it is received. It may also be contaminated during preparation and serving.

People may spread organisms from their bodies to food by touching, coughing, or sneezing.

Unsanitary facilities and equipment may spread organisms to people and/or food.

Disease-spreading pests, such as mice and flies, may be attracted to overcrowded or dirty food storage areas.

• *Meet the Culprits*

T E X T :

Most foodborne illnesses are caused by a relatively small number of microorganisms. They can't be seen, smelled, or tasted, but they're there. They're in food, on our bodies, on dirty counter tops and tables.

When allowed to grow and spread to prepared foods, these invisible invaders can become a serious health hazard, particularly for the very young, the very old, or for those suffering from underlying health problems.

Potentially harmful microorganisms include:

- bacteria
- viruses
- parasites
- fungi (yeasts and molds)

Of these, bacteria are most commonly implicated in outbreaks of foodborne illness.

Let's look at these culprits, one by one, to get an idea of who they are and how they operate.

Then we'll spend some extra time on bacteria, looking closely at some of the conditions that allow bacteria to grow and reproduce rapidly.

"Tricky *Trichinella*" - *Trichinella*

VISUAL OR HANDOUT:

Use Teaching Aid 3.2, "Meet Tricky *Trichinella*."

T E X T :

Trichinella is a parasite that depends on nutrients from a living host to complete its life cycle. It looks like a small, hairy, round worm.

People contract the disease trichinosis by eating undercooked pork or game that is infested with *Trichinella* larvae.

Fortunately, there has been much progress in reducing *Trichinella* in grain-fed hogs. As a result, human cases of trichinosis are now on the decline, but it's still important to take precautions.

Symptoms of trichinosis: Nausea, vomiting, and abdominal pain appear anywhere from 2 to 28 days after eating infected meat. Later, people may develop sore muscles, a fever, or a rash.

Preventing trichinosis: Cooking meat thoroughly will destroy any live *Trichinella* larvae and prevent trichinosis infection. Under carefully controlled conditions, curing, pickling, freezing, and canning are also effective prevention techniques.

"Brazen Botchy" - Clostridium Botulinum

VISUAL OR HANDOUT:

Use Teaching Aid 3.3, "Meet Brazen Botchy." Explain the following to trainees, then ask one of them to read out loud what "Botchy" has to say. (See note on next page.)

T E X T :

Found in soil and water, *Clostridium botulinum* bacteria produce a toxin (deadly poison) that causes illness. This illness is called botulism and is very serious.

How does this culprit take hold?

Under certain conditions, "Brazen Botchy" can produce a thick-walled spore that can become dormant and survive extremes of heat and cold. When held at temperatures above 38°F, this spore can become vegetative and produce a toxin.

Where found: Deadly toxins caused by this bacteria are *often found in canned foods* that have not been sealed at high-enough temperatures. A bulging can or jar lid is a sign that *Clostridium botulinum* bacteria are at work inside.

These bacteria *can also thrive in cooked foods* held at room or warm temperatures under low oxygen conditions. You may be surprised to learn, for example, that toxins may form at room temperature in vacuum-packed foods or potatoes wrapped in foil.

Symptoms of botulism: Symptoms appear 12 to 48 hours after eating an infected food. They include vomiting, double vision, droopy eyelids, difficulty speaking and swallowing, and breathing problems. *If left untreated, botulism can be fatal.*

Preventing botulism: There are several ways to prevent "Brazen Botchy" from causing harm.

Be sure to...

Keep cooked foods at an internal temperature of above 140°F.

Keep cold foods at an internal temperature of below 40°F.

Use proper quick-cooling procedures to store leftovers.

Reheat leftovers to an internal temperature of at least 165°F before serving.

Also...

Do not use bulging, leaking, or dented cans or cracked jars.

Discard cans that spurt liquid.

Never use home-canned foods of any type in a food service operation.

***NOTE:** At this point, ask a trainee to read what “Brazen Botchy” has to say on Teaching Aid 3.3.*

"Pesky Perfy" - Clostridium Perfringens

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.4, "Meet Pesky Perfy." Explain the following, then ask a trainee to read out loud what "Pesky Perfy" has to say.

T E X T :

A relative of "Brazen Botchy," *Clostridium perfringens* is also a rod-shaped bacteria that grows only where there is little or no oxygen. It can be found in the soil, in the intestines of humans and animals, and in sewage.

Like "Brazen Botchy," it can produce troublesome vegetative spores. These spores, which are resistant to cooking, can become vegetative and produce toxins at temperatures between 70°F and 120°F.

Clostridium perfringens often strikes food served in quantity and left for long periods on a steam table or at room temperature. For this reason, it's often called the "cafeteria germ."

Symptoms: Diarrhea and gas pains appear within 9 to 15 hours after eating an infected food and usually last about a day. *Clostridium perfringens* can have more serious effects on elderly people and ulcer patients.

Prevention: There are several ways to prevent this culprit from taking hold. Be sure to...

Clean produce thoroughly to remove all dirt.

Keep cooked foods at an internal temperature above 140°F, or below 40°F.

Use proper quick-cooling procedures to store cooked foods such as beef, turkey, gravy, dressing, stews, and casseroles.

Reheat leftovers to an internal temperature of at least 165°F before serving.

NOTE: At this point, ask a trainee to read what "Pesky Perfy" has to say on Teaching Aid 3.4.

"Cocky *E. Coli*" - *Escherichia Coli* (*E. Coli*)

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.5, "Meet Cocky *E. Coli*." Explain the following, then ask a trainee to read out loud what this culprit has to say.

T E X T :

There are several strains of *E. coli* that have long been known to cause diarrhea in infants and travelers. These strains are often found in water contaminated by human or animal waste.

This culprit can also cause serious food-related illness — for example, by getting into raw or rare ground beef, unpasteurized milk, unpasteurized juice, or beverages that contain unpasteurized juice.

These products can be a serious threat to vulnerable populations, such as the very young, the elderly, and people with compromised immune systems.

Toxins caused by *E. coli* are dangerous and may result in death.

Symptoms of food poisoning: Symptoms generally begin 3 to 8 days after the contaminated food is eaten. They include severe abdominal cramps followed by bloody diarrhea, nausea, vomiting, and occasionally a low-grade fever.

Symptoms can last up to 10 days and often require hospitalization. One strain of *E. coli* produces a toxin that can cause hemorrhagic colitis. A urinary tract infection is a possible complication that is a leading cause of acute kidney failure in children.

Prevention: Food must be thoroughly cooked and reheated. Good sanitation and refrigeration below 40°F are also essential.

When purchasing milk, juice, or beverages containing juice, buy only *pasteurized* products.

"Savage Sam" - Salmonella

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.6, "Meet Savage Sam." Explain the following, then ask a trainee to read out loud what this culprit has to say.

T E X T :

"Savage Sam" is one of the most troublesome culprits. In fact, *Salmonella* bacteria are responsible for approximately 40,000 reported cases of foodborne illness *each* year.

Salmonella bacteria cycle through the environment in the intestinal tracts of humans and animals. They are often found in raw or undercooked foods, such as poultry, eggs, and meat, and may also be present in unpasteurized milk.

Salmonella bacteria can spread to other foods through cross-contamination.

Symptoms: Stomach pain, diarrhea, nausea, chills, fever, and headache normally appear 6 to 48 hours after eating contaminated food. Symptoms can last 3 to 5 days.

Prevention: To prevent "Savage Sam" from contaminating the food you serve, be sure to *thoroughly cook* all meat, poultry, fish, eggs, and egg products. *Avoid contaminating* prepared foods with juices from raw foods. *In addition:*

Do not drink or serve unpasteurized milk.

Store and hold at below 40°F all potentially hazardous foods.

Use only dry or pasteurized eggs or egg products.

Do not use raw seed sprouts, such as alfalfa sprouts.

"Sinister Staph" - Staphylococcus Aureus

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.7, “Meet Sinister Staph.” Explain the following, then ask a trainee to read out loud what this culprit has to say.

T E X T :

Staphylococcus aureus bacteria are found on our skin, noses, and throats, and in infected cuts and pimples.

They thrive in cooked foods high in protein. They also thrive in foods high in sugar or salt — this is significant because sugar and salt are two elements that *inhibit* growth of *other* microorganisms.

Staph multiply rapidly at warm temperatures, producing a toxin that can cause illness. Although *thorough* cooking will kill staph bacteria, the toxins are resistant to heat, refrigeration, and freezing.

Symptoms: Nausea, vomiting, and diarrhea usually appear 30 minutes to 8 hours after eating and may last a day or two. The illness is usually not serious in healthy people, but can make them feel very sick.

Prevention: There are several ways to prevent “Savage Sam” from causing harm. Be sure to do the following:

Do not work with food if you have infected sores or open wounds.

Wash hands and utensils before preparing and serving food.

Cook foods thoroughly.

Refrigerate cooked foods that will not be served immediately. Refrigerate these foods in shallow, covered containers.

Do not let prepared foods sit at room temperature for more than 2 hours. This is particularly important for cooked and cured meats and cheese and meat salads.

"Voracious Viruses" - Viruses

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.8, "Meet the Voracious Viruses." Explain the following, then ask a trainee to read out loud what these culprits have to say.

T E X T :

Viruses are another type of hazardous microorganism found in food service environments.

Unlike bacteria, viruses cannot reproduce outside a living organism because they are not complete cells. Because of this, they do not multiply in food but rather may be transported on food, food surfaces, and utensils. Once inside a human host, they can reproduce and cause illness.

Viral outbreaks are most commonly associated with poor personal hygiene or a contaminated water supply. However, they can also be food-related.

For example, when eaten raw or undercooked, shellfish such as oysters, mussels, and clams that have been illegally harvested from polluted water may cause foodborne viral illnesses. As a result, seafood should always be purchased from vendors with approved health-inspected facilities.

Prevention of viral contamination should include proper handwashing, proper personal hygiene, employee health (no fever, no diarrhea), and no bare-hand contact with ready-to-eat food.

"Frightening Fungi" - Molds and Yeasts

VISUAL OR HANDOUT:

Display or hand out Teaching Aid 3.9, "Meet the Frightening Fungi." Explain the following, then ask a trainee to read out loud what "Frightening Fungi" have to say.

T E X T :

Fungi are found naturally throughout the environment. Yeasts, molds, mildew, and mushrooms are all types of fungi. The two kinds of fungi that typically cause problems in a food service operation are molds and yeasts.

Although individual mold cells are microscopic, they grow quickly and soon become visible to the naked eye. Molds spoil food, causing discoloration and an unpleasant smell and taste.

Molds can grow on almost any food in any condition — moist, dry, acidic, non-acidic, salty, or sweet. A few cheeses, such as brie, are processed to have a natural and safe mold coating.

Toxins can be dangerous: Contrary to popular belief, certain molds can be dangerous to humans. They produce toxins, some of which have been linked to cancer in animals and to rare, isolated incidents of foodborne illness. Other molds can cause serious infections and allergies.

Some foods may need to be discarded: Although the cells and spores of molds can be killed by heating foods to 140°F for 10 minutes, the *toxins are heat stable* and are not destroyed. Therefore, foods with molds that are not a natural part of the food should be discarded.

Jellies, honey, and fruit juices often harbor sugar-loving yeasts. While there is no evidence that yeasts found in food cause illness, they do spoil food, as evidenced by bubbles and an alcoholic smell or taste.

• A Closer Look at Bacteria

VISUAL OR HANDOUT:

Use Teaching Aid 3.10, “What Are Bacteria?”

T E X T :

Now that you’ve met “Brazen Botchy” (*Clostridium botulinum*) and “Pesky Perfy” (*Clostridium perfringens*), you probably have a general idea of what bacteria are.

Since bacteria are responsible for most outbreaks of foodborne illness, let’s look more closely at these culprits and find out what allows them to multiply so rapidly under certain conditions.

First, a definition: The word “bacteria” is actually the plural of the Latin word “bacterium.” A bacterium is a living organism made up of a single cell.

Some bacteria, called pathogens, are disease-causing in themselves. Others discharge poisons, called toxins, as they multiply. As we’ve seen, “Brazen Botchy” and “Pesky Perfy” are both toxin-producing bacteria.

How Bacteria Reproduce

VISUAL OR HANDOUT:

Use Teaching Aid 3.11, “How Do Bacteria Reproduce?”

T E X T :

Bacteria are considered “*vegetative*” because they can grow and reproduce. Under certain conditions, they will reproduce very rapidly.

In fact, in an environment that is ideal for growth, a single bacterial cell can turn into *billions* in only 10 or 12 hours!

Certain vegetative bacteria protect themselves by producing a thick-walled spore within the bacterial cell. A spore can become dormant and survive unfavorable environmental conditions such as boiling water, freezing temperatures, and some sanitizing solutions.

Given warmth, moisture, and a little food, these spores may become vegetative and reproduce very easily. The vegetative cell simply enlarges and splits in two; these “offspring” then divide to create two more bacteria, and so on. This type of reproduction results in extremely rapid population growth.

Five Factors of Bacterial Growth

VISUAL OR HANDOUT:

Use Teaching Aid 3.12, “Five Factors of Bacterial Growth.”

T E X T :

Bacterial growth depends on five factors: food, moisture, time, temperature, and pH.

Factor #1: Food

T E X T :

Bacteria feed on protein and carbohydrates. Any food that contains these ingredients can promote the growth of infectious bacteria and is therefore potentially hazardous.

All animal products are potentially hazardous.

Vegetables and plant products may also be hazardous once they are cooked. This is because cooking destroys protective barriers in plants and converts proteins and carbohydrates into a form more usable by microorganisms. This makes vegetables and plant products, such as potatoes, tofu, beans, winter squash, and rice, potentially hazardous once they are cooked.

Use Teaching Aid 3.13, “Potentially Hazardous Foods.”

VISUAL OR HANDOUT:

The U.S. Public Health Service classifies foods as potentially hazardous. Some examples include:

T E X T :

- Any food that consists in whole or in part of milk or milk products.
- Shell eggs.
- Meats, poultry, fish, and shellfish, edible crustacea (shrimp, lobster, crab, etc).
- Baked or boiled potatoes, and other cooked vegetables.
- Tofu and other soy protein foods.
- Shelf-stable foods, once removed from their containers.
- Raw seed sprouts, cut melons, or synthetic ingredients.

Factor #2: Moisture

VISUAL OR HANDOUT:

Use Teaching Aid 3.14, “Moisture as a Factor of Bacterial Growth.”

T E X T :

In addition to food, bacteria need water for growth and development. Because they cannot take in solids, bacteria get their nutrients from water solutions.

Most fresh foods contain the ideal amount of water for bacterial growth.

Sugar products, cereal products, dried fruits, jams, and jellies have low moisture levels and are, therefore, resistant to bacteria.

It is possible to lower the amount of moisture in food through freezing, dehydrating, adding sugar or salt, or cooking. However, while bacteria cannot grow in foods low in moisture, they remain alive and can become potentially hazardous when moisture is added in cooking. For example, dry foods such as beans, pasta, and rice become vulnerable to bacteria when cooked.

Factors #3 and #4: Time and Temperature

VISUAL OR HANDOUT:

Use Teaching Aid 3.15, “Temperature as a Factor of Bacterial Growth.”

T E X T :

Given a little time and a nice warm environment, bacteria multiply rapidly. The temperature range between 40°F and 140°F is known as the *temperature danger zone*. Holding food in the “temperature danger zone” is one of the primary causes of foodborne illness outbreaks.

(Some local and state agencies have adopted different temperature safety zones. For example, in some areas, state and local codes set this zone at 41°F to 145°F. Be sure to follow codes in your area.)

A few bacteria seem to grow and multiply between 32°F and 45°F, and some can survive at temperatures as low as 19°F. For this reason, it is important to monitor the length of time a product is kept in refrigeration.

VISUAL OR HANDOUT:

Use Teaching Aid 3.16, “Time as a Factor of Bacterial Growth.”

T E X T :

It is important to note that exposure to the danger zone is cumulative — it adds up at each stage of the food-handling process. From thawing to serving, the maximum time a potentially hazardous food should be left in the “temperature danger zone” is 4 hours.

As a general rule, cool all potentially hazardous foods rapidly and maintain an internal temperature below 40°F or above 140°F throughout the food-handling process.

Factor #5: Acidity vs. Alkalinity (pH)

VISUAL OR HANDOUT:

Use Teaching Aid 3.17, “Acidity vs. Alkalinity (pH) as a Factor of Bacterial Growth.”

T E X T :

The indicator known as “pH” indicates how acidic or alkaline (“basic”) a food or other substance is. The pH scale ranges from 0.0 to 14.0, with 7.0 being exactly neutral. Distilled water, for example, has a neutral pH of 7.0.

Bacteria grow best in foods that are neutral or slightly acidic, in the pH range of 4.6 to 7.0.

Highly acidic foods, such as vinegar and most fresh fruits, inhibit bacterial growth.

Meats and many other foods have an optimal pH value for bacterial growth.

On the other hand, foods normally considered hazardous, such as mayonnaise and custard filling, can be safely stored at room temperature if their pH is below 4.6.

Lowering the pH of foods by adding acidic ingredients, such as making sauerkraut from cabbage or pickles from cucumbers, may render them non-potentially hazardous. This is not a foolproof prevention method, however.

For example, although commercially prepared mayonnaise has a pH below 4.6, adding it to a meat salad will not inhibit bacteria. The pH and moisture in the meat is likely to raise the pH of the salad to a point where bacteria can multiply.

• *Avoid Cross-Contamination*

VISUAL OR HANDOUT:

Use Teaching Aid 3.18, “Avoid Cross-Contamination!”

T E X T :

One of the most common causes of foodborne illness is cross-contamination: the transfer of bacteria from food to food, hand to food, or equipment to food.

Food to Food: Raw, contaminated ingredients may be added to foods, or fluids from raw foods may drip into foods that receive no further cooking. A common mistake is to leave thawing meat on a top shelf in the refrigerator where it can drip down onto prepared foods stored below.

Hand to Food: Bacteria are found throughout the body—in the hair, on the skin, in clothing, in the mouth, nose, and throat, in the intestinal tract, and on scabs or scars from skin wounds. These bacteria often end up on the hands where they can easily spread to food. People can also pick up bacteria by touching raw food, then transfer it to cooked or ready-to-eat food.

Equipment to Food: Bacteria may pass from equipment to food when equipment that has touched contaminated food is then used to prepare other food without proper cleaning and sanitizing. For example, cross-contamination can occur when surfaces used for cutting raw poultry are then used to cut foods that will be eaten raw, such as fresh vegetables.

Coverings such as plastic wrap and holding and serving containers can also harbor bacteria that can spread to food. A can opener or food slicer can also become a source of cross-contamination if not properly sanitized between use.

Teaching Aids to Use With Chapter 3: "Focus on Foodborne Illness"

- How Do Harmful Organisms Invade the Food Service Environment? *Teaching Aid 3.1*
- Meet "Tricky Trichinella" *Teaching Aid 3.2*
- Meet "Brazen Botchy" *Teaching Aid 3.3*
- Meet "Pesky Perfy" *Teaching Aid 3.4*
- Meet "Cocky E. Coli" *Teaching Aid 3.5*
- Meet "Savage Sam" *Teaching Aid 3.6*
- Meet "Sinister Staph" *Teaching Aid 3.7*
- Meet the "Voracious Viruses" *Teaching Aid 3.8*
- Meet the "Frightening Fungi" *Teaching Aid 3.9*
- What Are Bacteria? *Teaching Aid 3.10*
- How Do Bacteria Reproduce? *Teaching Aid 3.11*
- Five Factors of Bacterial Growth *Teaching Aid 3.12*
- Potentially Hazardous Foods *Teaching Aid 3.13*
- Moisture as a Factor of Bacterial Growth *Teaching Aid 3.14*
- Temperature as a Factor of Bacterial Growth *Teaching Aid 3.15*
- Time as a Factor of Bacterial Growth *Teaching Aid 3.16*
- Acidity vs. Alkalinity (pH) as a Factor of Bacterial Growth *Teaching Aid 3.17*
- Avoid Cross-Contamination! *Teaching Aid 3.18*
- Bacteria Farm *Teaching Aid 3.19*
(Group Activity)

How Do Harmful Organisms Invade the Food Service Environment?

- Food
- People
- Unsanitary facilities and equipment
- Disease-spreading pests

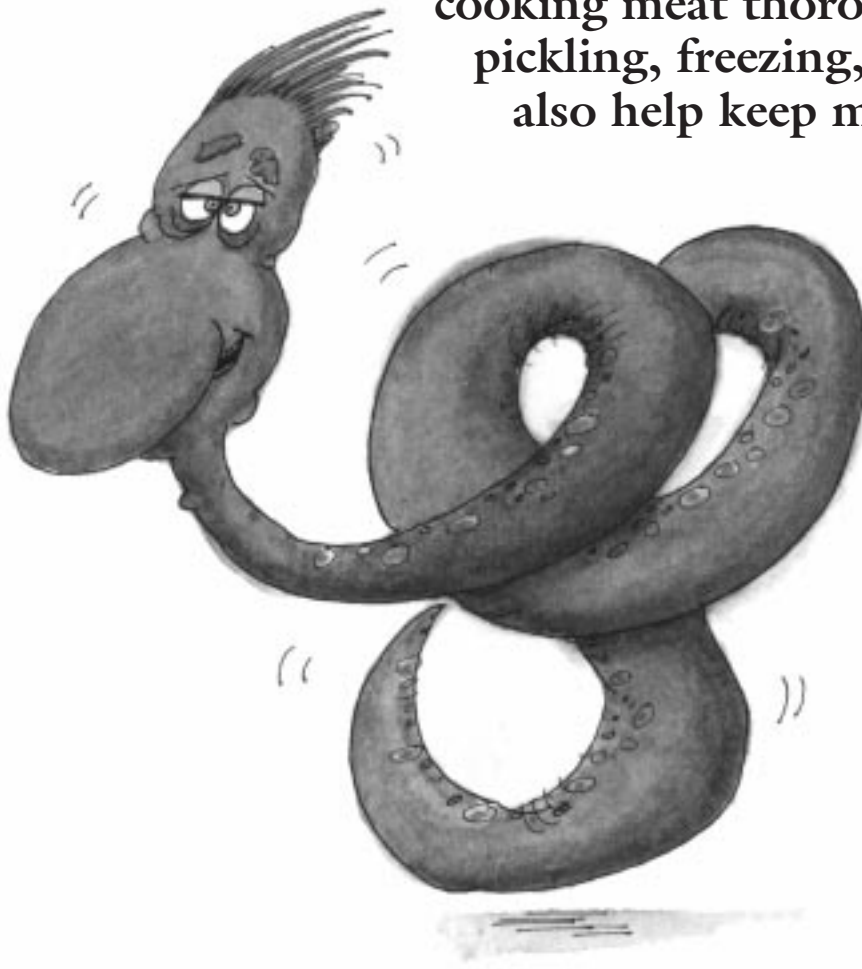
Teaching Aid 3.1 -
“How Do Harmful
Organisms Invade the
Food Service
Environment?”

Meet "Tricky Trichinella"

(*Trichinella Spiralis*)

"I'm a parasite. That means I live off a living host. I can spread to humans if they eat undercooked game or pork..."

"You can prevent me from taking hold by cooking meat thoroughly. Proper curing, pickling, freezing, cooking, and canning also help keep me under control..."

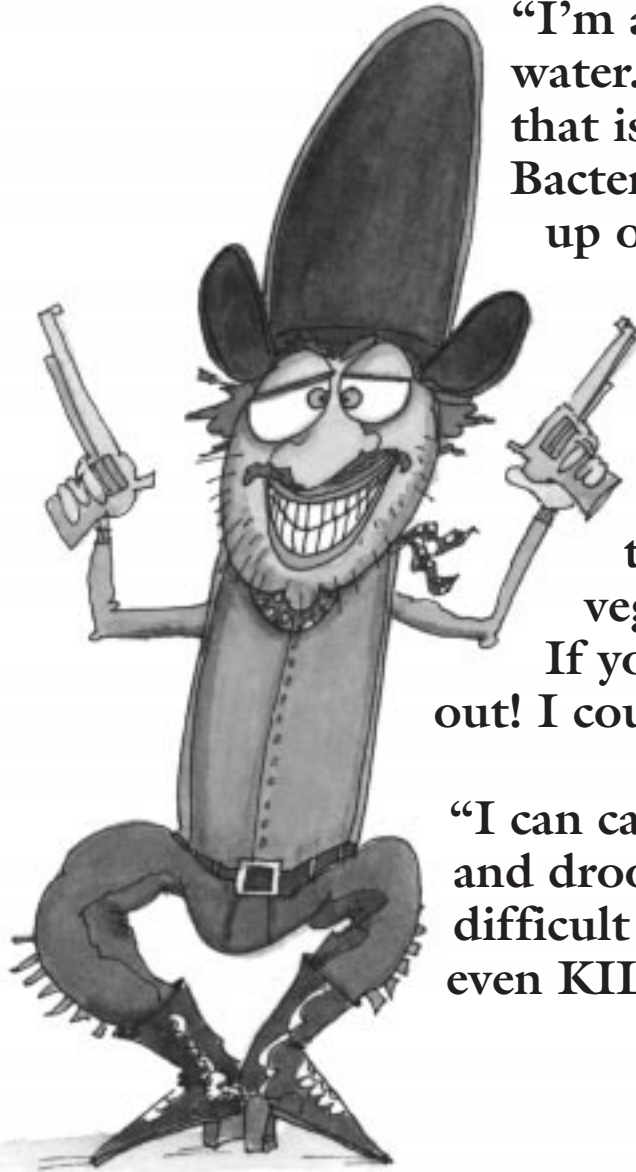


"I'm no fun! I cause *trichinosis*, which makes people vomit and have abdominal pain. In time, they may also have sore muscles, a fever, and even a rash."

Teaching Aid 3.2 -
"Tricky Trichinella"
(*Trichinella*)

Meet “Brazen Botchy”

(*Clostridium Botulinum*)



“I’m a bacterium found in soil and water. ‘Bacterium’ is a Latin word that is the singular of ‘bacteria.’ Bacteria are living organisms made up of single cells. Not all bacteria are harmful, but I sure can be!

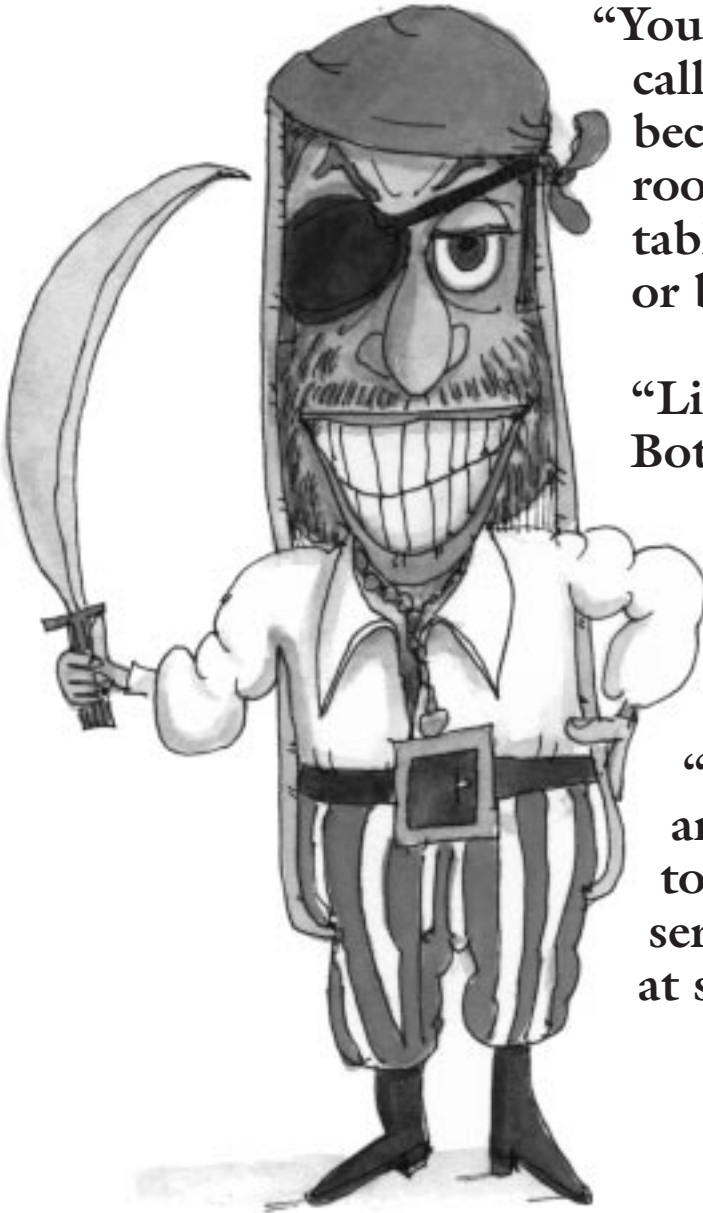
“I produce a toxin that can make you **VERY** sick. You may be able to kill me with thorough cooking, but my vegetative spores may **SURVIVE**. If you see a bulging can, throw it out! I could be at work inside...

“I can cause vomiting, double vision, and droopy eyelids, and make it difficult to speak or swallow. I may even **KILL** you!”

Teaching Aid 3.3 -
“Brazen Botchy”
(*Clostridium Botulinum*)

Meet "Pesky Perfy"

(*Clostridium Perfringens*)



"You may have heard of me. They call me the 'cafeteria germ' because I love foods held at room temperature, or in steam tables at temperatures of 140°F or below...

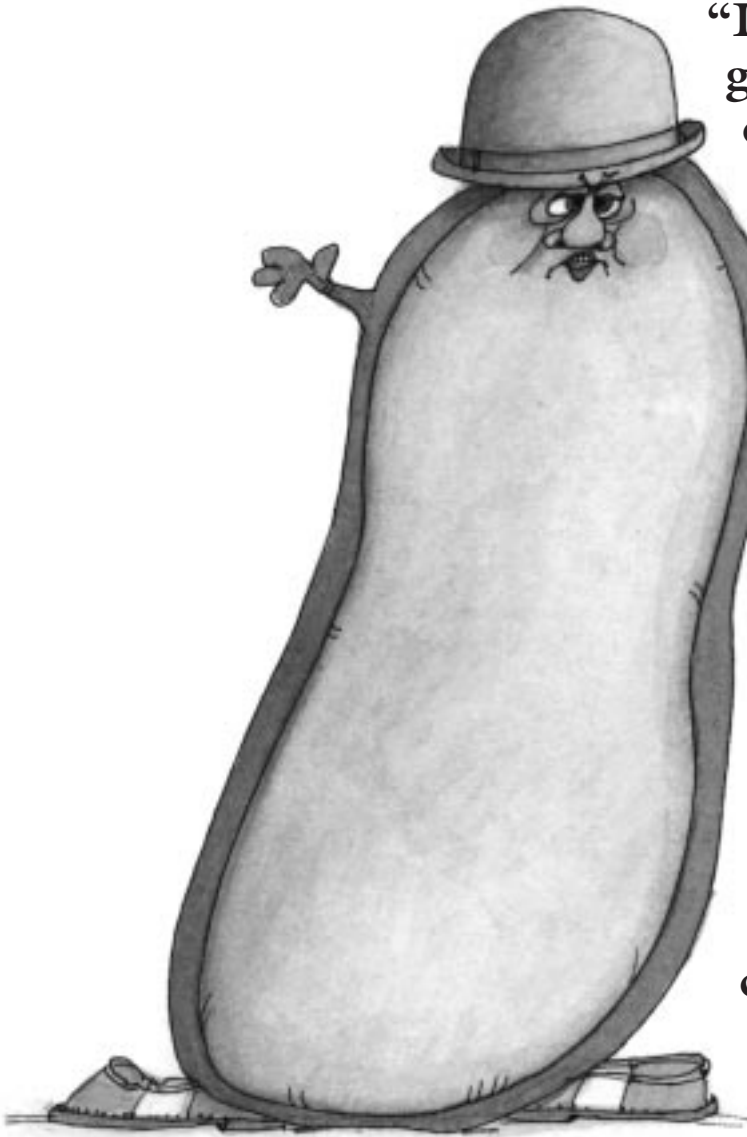
"Like my cousin 'Brazen Botchy,' I live in the soil and am resistant to cooking. I can also be found in the intestines of humans and animals or in sewage...

"When eaten, I cause diarrhea and gas pains. You may be able to STOP me by holding and serving foods in small portions at safe temperatures."

Teaching Aid 3.4 -
"Pesky Perfy"
(*Clostridium*
Perfringens)

Meet "Cocky E. Coli"

(*Escherichia Coli*)



"If you eat raw or rare ground beef, or drink contaminated water, you may get to meet ME. I can also sneak into unpasteurized milk, unpasteurized juices, and beverages that contain unpasteurized juice.

"I'm not much FUN — unless you don't mind a little diarrhea, nausea, and vomiting for a couple of weeks. I may even throw in a low-grade fever, chronic kidney failure, or even cause death.

"If you'd rather not make MY acquaintance, store cold foods below 40°F, cook or reheat foods thoroughly, and practice proper sanitation techniques."

Teaching Aid 3.5 -
"Cocky E. Coli"
(*Escherichia Coli*)

Meet "Savage Sam" (Salmonella)



"I'm a bacterium who's **ALWAYS** on the move — from the intestinal tracts of humans and animals to raw poultry, eggs, meat, and unpasteurized milk. I'll hop a ride on your hands or a utensil, and spread to other foods, too..."

"Each year, I'm **PERSONALLY** responsible for about 40,000 reported cases of stomach pain, diarrhea, nausea, chills, fever, and headaches..."

"There are only a few ways to **STOP** me. I hate hot and cold, so keep hazardous foods below 40°F and cook them thoroughly. Also, be careful not to cross-contaminate, and avoid unpasteurized milk."

Teaching Aid 3.6 -
"Savage Sam"
(Salmonella)

Meet “Sinister Staph”

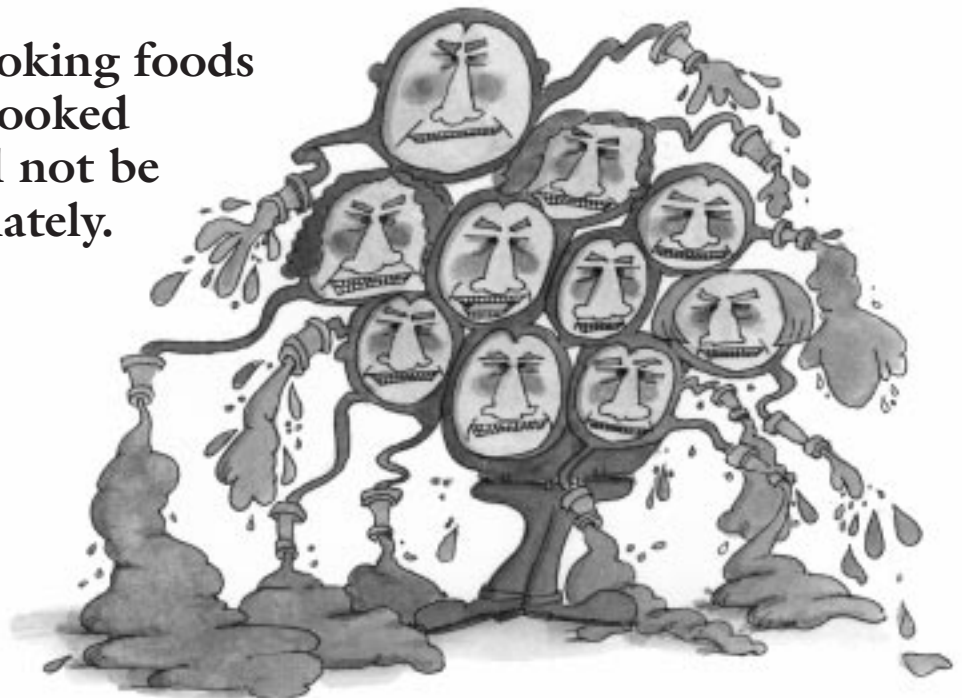
(*Staphylococcus Aureus*)

“We love people. We HANG AROUND their skin, noses, and throats, and in infected cuts and pimples — just waiting for the chance to jump into foods high in protein, sugar, or salt...

“We multiply rapidly where it’s warm — like in prepared foods held at room temperature. Although it is possible to COOK us to death, we can SURVIVE heat, refrigeration, and freezing. You can PREVENT us from making people sick by:

- covering open or infected wounds
- washing your hands and utensils before preparing and serving food
- thoroughly cooking foods
- refrigerating cooked foods that will not be served immediately.

“Watch out for us!
We’re tough
characters.”

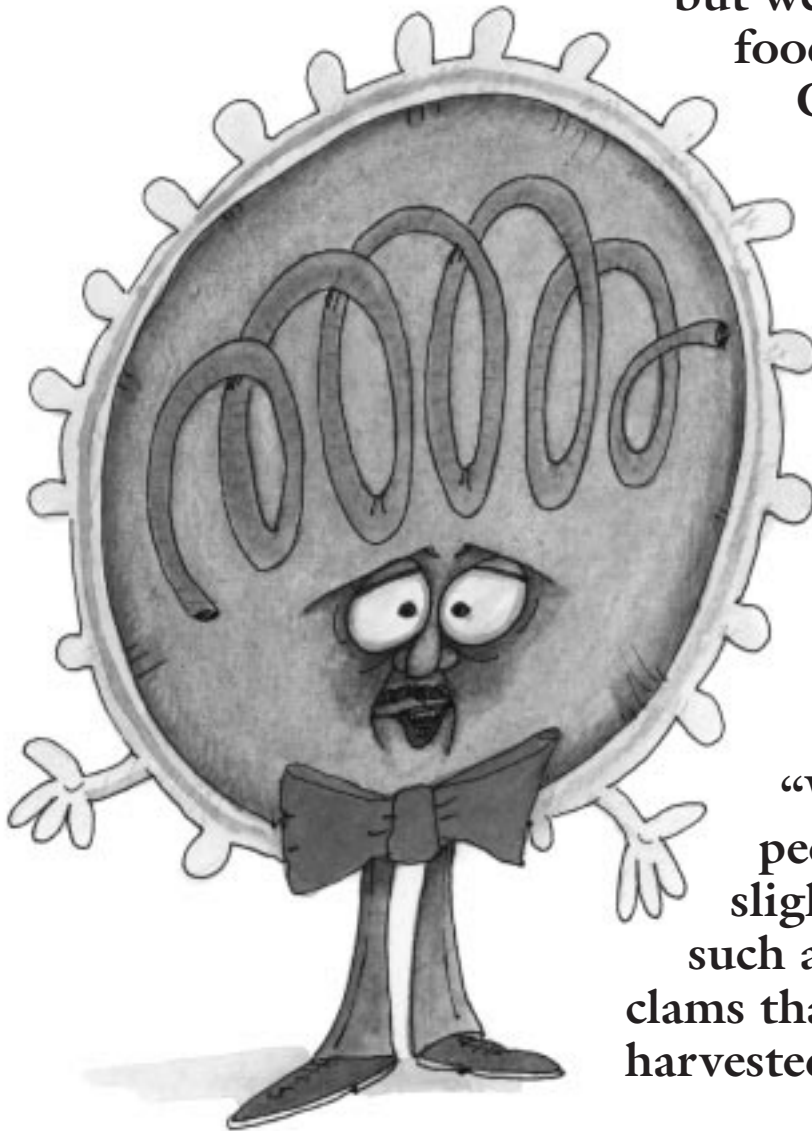


Teaching Aid 3.7 -
“Sinister Staph”
(*Staphylococcus Aureus*)

Meet the "Voracious Viruses"

(Viruses)

"I'm a virus. We viruses don't live **IN** food but we do move around the food service environment **ON** food and on surfaces that come in contact with food..."

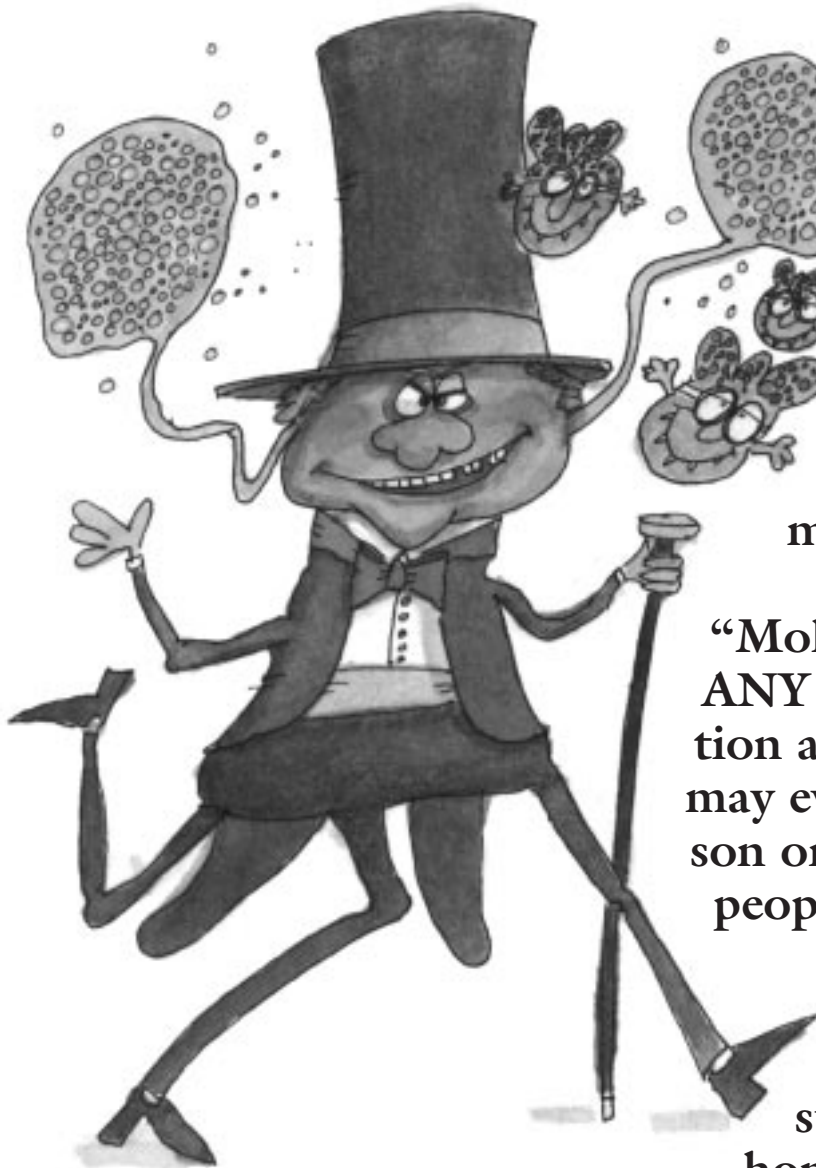


"When we get **INSIDE** a human host, we can reproduce and cause illness. Poor personal hygiene or a contaminated water supply help us spread..."

"We may also infect people who eat raw or slightly cooked shellfish, such as oysters, mussels, and clams that have been illegally harvested from polluted water."

Teaching Aid 3.8 -
"Voracious Viruses"
(Viruses)

Meet the “Frightening Fungi” (Fungi)



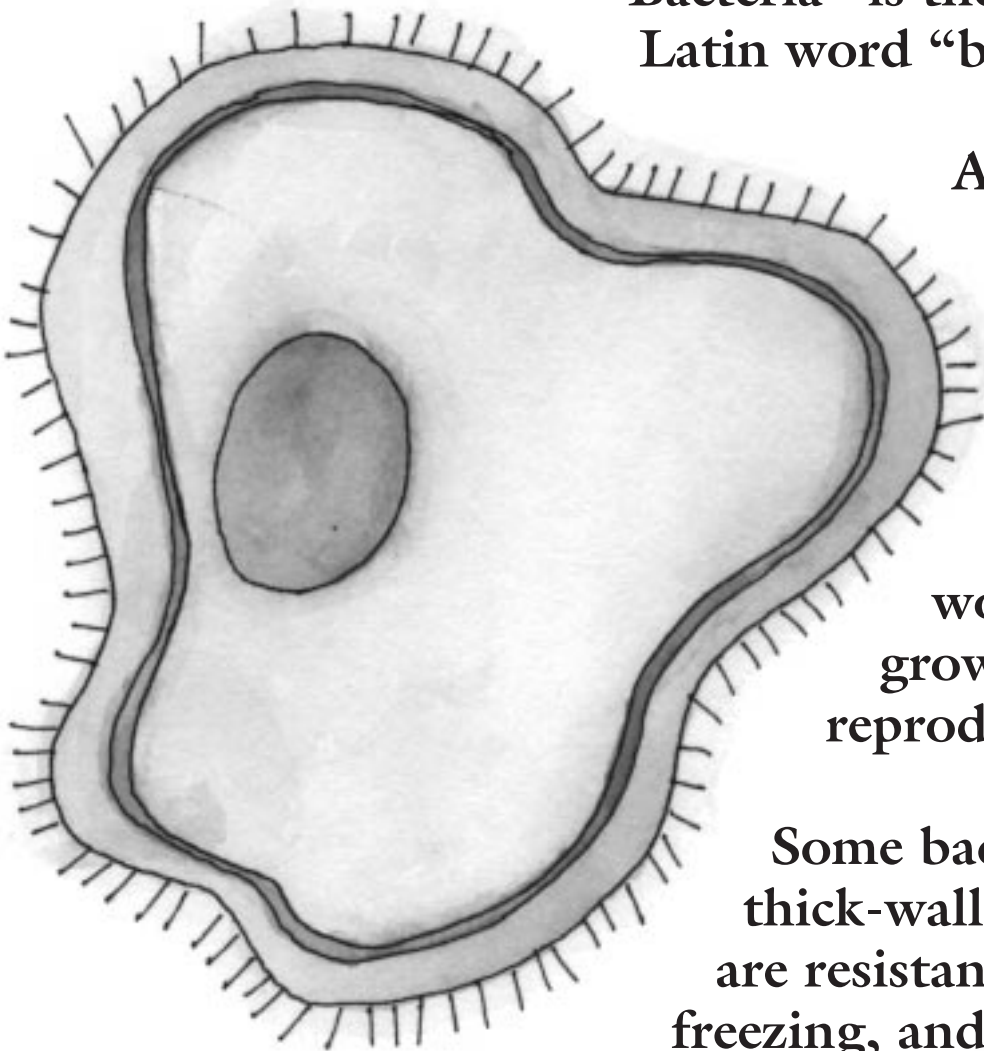
“My species exists throughout the environment in many forms — mushrooms, mildew, molds, yeasts. We’re all brothers, but the only fungi that **SPOIL** foods are molds and yeasts...

“Molds can spoil just about **ANY** food, causing discoloration and a bad flavor. They may even produce a mild poison or toxin that can make people sick. Yeasts don’t cause illness, but they do like to cause bubbles and an alcoholic taste in sugary foods like jellies, honey, and fruit juices.”

Teaching Aid 3.9 -
“Frightening Fungi”
(Fungi)

What Are Bacteria?

“Bacteria” is the plural of the Latin word “bacterium.”

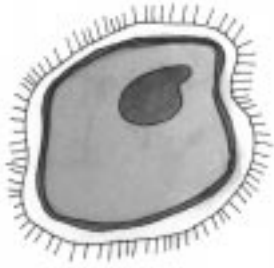


A “bacterium” is a single-celled organism that is “vegetative.”

In other words, it may grow and reproduce.

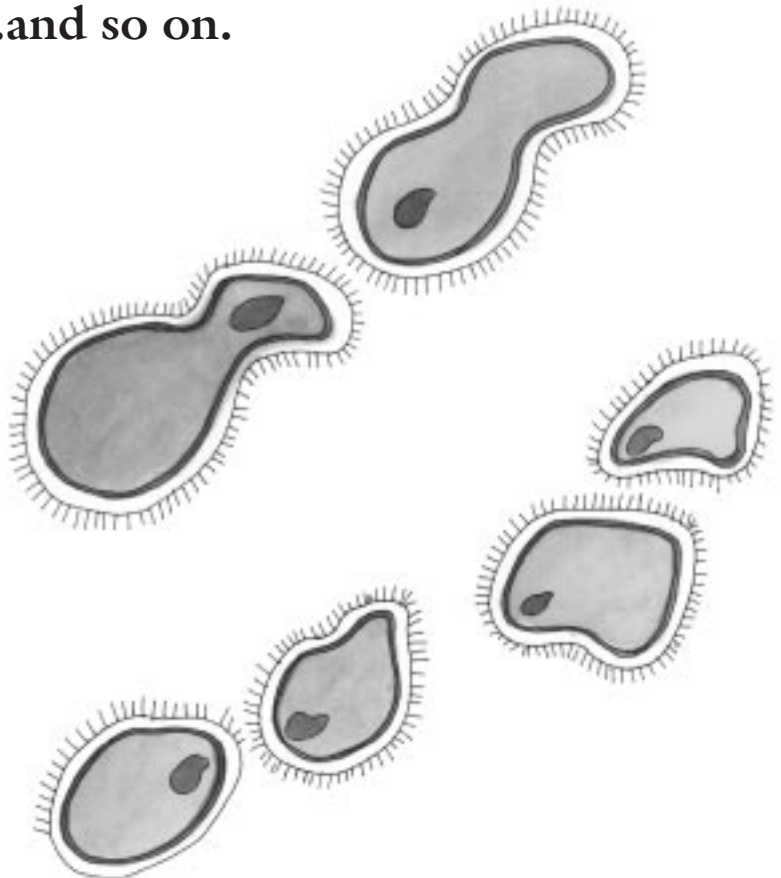
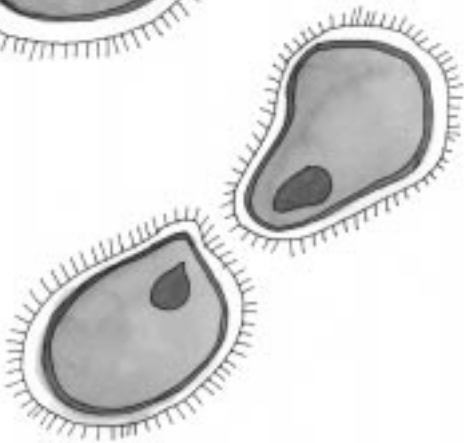
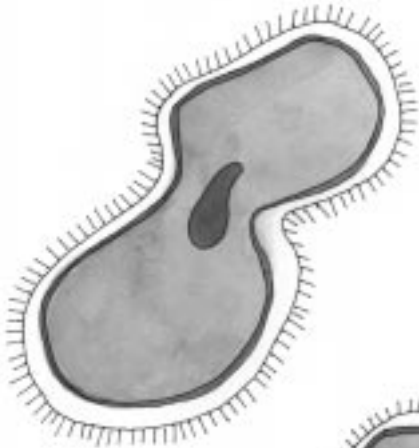
Some bacteria produce thick-walled spores that are resistant to boiling, freezing, and some sanitizing solutions.

How Do Bacteria Reproduce?



Given warmth, moisture, and a little food, bacterial spores may become vegetative and reproduce rapidly. How do they do this?

1. The vegetative cell enlarges and splits in two.
2. The offspring divide to create two more bacteria....
3. ...and so on.



Teaching Aid 3.11 -
“How Do Bacteria
Reproduce?”

Five Factors of Bacterial Growth

1. Food
2. Moisture
3. Temperature
4. Time
5. pH (acidity vs. alkalinity)

Teaching Aid 3.12 -
“Five Factors of
Bacterial Growth”

Potentially Hazardous Foods

The U.S. Public Health Service classifies foods as potentially hazardous. Some examples include:

- Any food that consists in whole or in part of milk or milk products.
- Shell eggs.
- Meats, poultry, fish, and shellfish, edible crustacea (shrimp, lobster, crab, etc.)
- Baked or boiled potatoes, and other cooked vegetables.
- Tofu and other soy protein foods.
- Shelf-stable foods, once removed from their containers.
- Raw seed sprouts, cut melons, or synthetic ingredients.

Teaching Aid 3.13 -
“Potentially Hazardous
Foods”

Moisture as a Factor of Bacterial Growth



FRESH FOODS (such as produce, milk, and meat) contain the ideal amount of water for bacterial growth.

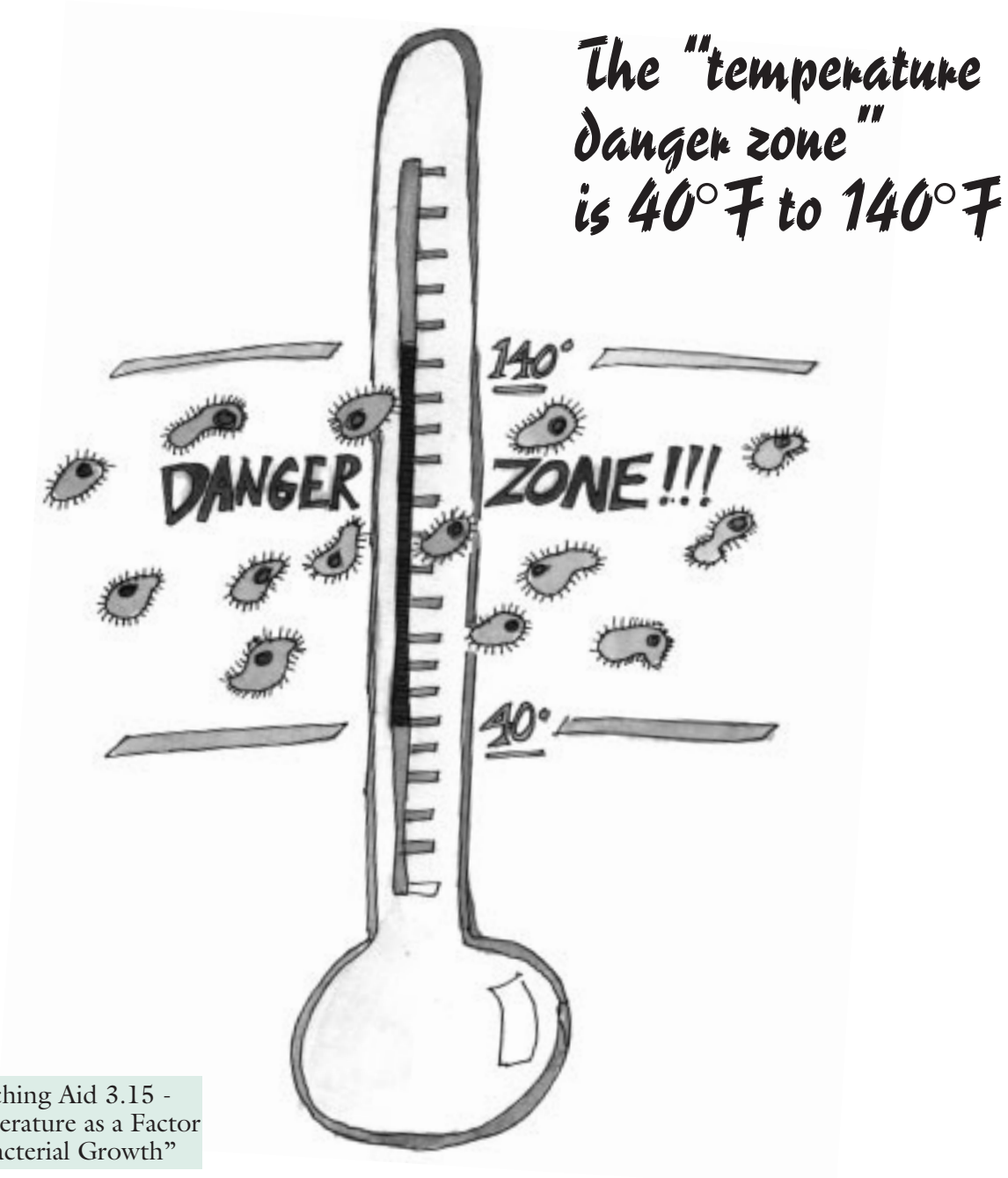
LOW-MOISTURE FOODS (like cereal, jelly, and sugar) are resistant to bacteria.



DRY FOODS (such as rice, beans, and pasta) become vulnerable to bacteria when moisture is added, for example, during cooking.

Teaching Aid 3.14 -
“Moisture as a Factor
of Bacterial Growth”

Temperature as a Factor of Bacterial Growth



Teaching Aid 3.15 -
"Temperature as a Factor
of Bacterial Growth"

Time as a Factor of Bacterial Growth

Exposure to the danger zone is cumulative; in other words, it adds up at each stage of the food-handling process. From thawing to serving, the maximum time a potentially hazardous food should be left in the “temperature danger zone” is 4 hours.

If allowed to thrive, one bacterium can become more than 1 million bacteria in just 4 hours.

Teaching Aid 3.16 -
“Time as a Factor of
Bacterial Growth”

Acidity vs. Alkalinity (pH) as a Factor of Bacterial Growth

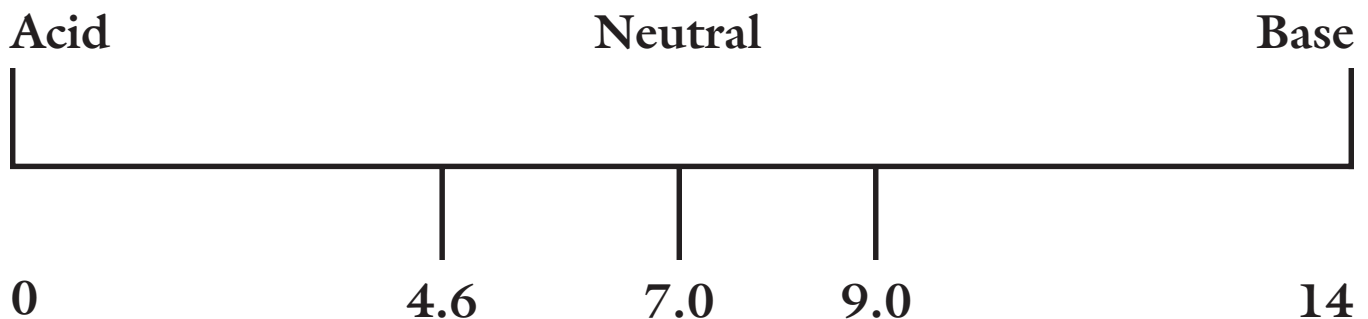
If the pH is:

Below 4.6..... Bacteria will not grow well.

Between 4.6 and 7.0.... Bacteria will thrive.

Between 7.0 and 9.0.... Bacteria may survive.

pH Scale



Teaching Aid 3.17 -
“Acidity vs. Alkalinity
(pH)”

Avoid Cross-Contamination!

Unless everyone is VERY careful, cross-contamination can be a problem in a food service environment.

What are the **THREE WAYS** cross-contamination can occur?

- Food to Food
- Hand to Food
- Equipment to Food

Teaching Aid 3.18 -
“Avoid Cross-
Contamination!”

Teaching Aid 3.19: "Bacteria Farm"

(Instructions for Presenters)

This is a group activity. Use it to wrap up Chapter 3.

First, you'll need...

Cotton swabs

Petri Dishes with Agar

If you are unable to obtain a set of agar-filled petri dishes from your school or local health department, you can make your own culture medium. Here's how:

Add 2 teaspoons of unflavored gelatin (1 packet) and 2 teaspoons of sugar to $\frac{2}{3}$ cup of water.

Bring the solution to a boil and stir for 1 minute until everything is dissolved. Pour $\frac{1}{4}$ inch of the solution into each petri dish or other suitable plastic container.

Then, have employees find the bacteria that are lurking around their food preparation area. Ask them to...

1. Pluck a hair and lay it on a petri dish.
2. Sneeze or cough into a petri dish.
3. Run a cotton swab around a nostril and carefully zigzag it across the agar in the petri dish.
4. Run a cotton swab around the food contact area of the slicer and carefully zigzag it across the agar in the petri dish.
5. Run a cotton swab around a clean counter top and carefully zigzag it across the agar in the petri dish.
6. Use the same procedure to collect additional samples from any other area in which bacteria may be present.
7. Finally, store petri dishes in a warm environment, at a constant temperature of 80°F or above. Check your specimens periodically. Within a week, you should see them grow!

Teaching Aid 3.19 -
"Bacteria Farm"
(Instructions for
Presenters)